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LEARNING FROM PROSE MATERIAL.

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THIS STUDY REPLICATED ROTHKOPF'S 1965 STUDY TO INVESTIGATE THE EFFECT OF LENGTH OF READING PASSAGE, POSITION OF QUESTIONS, AND KNOWLEDGE OF RESULTS ON THE RETENTION OF INFORMATION. TWENTY PARAGRAPHS OF BIOGRAPHICAL MATERIAL WERE SELECTED, AND TWO MULTIPLE-CHOICE QUESTIONS REQUIRING RECALL OF SPECIFIC FACTUAL INFORMATION WERE CONSTRUCTED FOR EACH PARAGRAPH, TOTALLING 20 RETENTION QUESTIONS AND 20 INCIDENTAL QUESTIONS. THESE WERE PRESENTED IN CONVENTIONAL PROGRAMED FORM FOLLOWING A PARAGRAPH-QUESTION-KNOWLEDGE OF RESULTS SEQUENCE WHICH VARIED ACCORDING TO THE EXPERIMENTAL GROUPS COMPOSED OF 72 EDUCATIONAL PSYCHOLOGY STUDENTS. SEVEN OTHERS SERVED AS THE CONTROL GROUP. RESULTS SUPPORTED ROTHKOPF'S FINDINGS THAT QUESTIONS HAVE A GENERAL FACILITATIVE EFFECT ON RETENTION AND THAT RETENTION IS IMPROVED WHEN KNOWLEDGE OF RESULTS IS PROVIDED. THE LONGER THE PASSAGE, THE BETTER THE RETENTION OF INCIDENTAL MATERIALS. HOWEVER, RETENTION QUESTIONS WERE MORE EFFECTIVE WITH PASSAGES OF MODERATE LENGTH. QUESTIONS, RETENTION OR INCIDENTIAL, PLACED BEFORE THE PASSAGE REDUCED THE RETENTION OF INFORMATION. THE POSITION OF QUESTIONS, HOWEVER, DID NOT MAKE MUCH DIFFERENCE IF KNOWLEDGE OF RESULTS WAS PROVIDED. QUESTIONS WERE MOST USEFUL AFTER THE PASSAGE, IF KNOWLEDGE OF RESULTS WAS NOT PROVIDED. THIS PAPER WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION MEETING (NEW YORK, FEBRUARY 1967). (NS)

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This study dealt with the effect of factual questions upon the retention of information from prose material. If questions are to be used as study aids with prose passages, what is the optimal spacing of these questions? Are questions more useful before the passages (as guidance), or are they more useful after the passages (in a review capacity)? If questions come before the reading passage subjects may tend to focus on question-relevant content within the passage and hence retention of other material within the passage would be relatively low. Such a view would be consistent with the cybernetic approach of Smith and Smith (1966), which assumes that a test question provides a criterion to use during reading — a criterion of what is and is not relevant. An alternative approach, the view of Rothkopf (1965), stresses the role of mathemagenic or attentive behaviors which are under the control of the test questions.

The present study attempted to replicate the results of a study by Rothkopf (1965), which showed, briefly, that questions have a general facilitative effect upon retention and that retention of specific questions is improved when knowledge of results is available. This study differs from the Rothkopf study in that the prose materials were different, only multiple choice questions were used in the present study, the present materials were about half the total length of those used by Rothkopf, and, an additional variable was added in this study -- length of passage before a question was introduced. The hypothesis here was that if prose passages are too short the prose structure loses control over behavior. If passages are too long -- questions lose control over behavior.

To summarize, the present study investigated the interaction of length of passage, position of questions, and the availability of knowledge of results. The effect of these variables upon the immediate retention of information which was relevant or incidental to the questions asked during reading was analyzed (I refer you to Table 2 for a summary of the design).

METHOD

Twenty 10-line paragraphs of biographical material on Henry James were selected from Miller's introductory text. Two multiple-choice questions which required the recall of specific factual information (such as a course of study undertaken by James) were constructed for each paragraph. The reading material took the form of conventional programmed booklets. On one sheet of paper the subject found a paragraph of prose material, on the next page a question over that material, and on the following page knowledge of results was given by repeating the correct alternative along with the stem of the question. The sequence of paragraph-question-knowledge of results that a subject saw depended upon the experimental group to which he was assigned.

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Seventy-two introductory educational psychology students were the subjects. The three factors in the design were: 1. questions before or after prose passages, 2. length of passages between questions (10, 20, or 40 lines long), and 3. knowledge of results present or absent following the questions.

Two dependent measures were obtained immediately after the reading task: 1. the number of correct responses to the 20 questions which had been used with the reading passages (called retention questions), and 2. the number of correct responses to the 20 questions covering material not questioned in the reading task (called incidental questions).

A control group of seven subjects was run to give a baseline level of responding by simply reading through the prose material.

RESULTS

The results of the present study agree quite well with the data of Rothkopf's study. I refer you to Table 1 which presents these data for comparison. There is a significant rank order correlation between the two sets of data.

In regard to retention questions, there was a significant main effect for all three factors. Here I refer you again to Table 2. It can be seen that presenting questions before the reading of paragraphs had the least facilitating effect upon retention. There was a significant interaction between the position of questions and whether or not knowledge of results was available. The results suggest that the position of retention questions in the prose does not make much difference if knowledge of results is provided. If knowledge of results is not provided, then the questions are most useful following the reading passage.

Data on length of passages reveal that the moderate length was an optimal level in terms of the retention questions. If passages are too long, associations between questions and content may be difficult to establish. If passages are too short, necessary continuity among prose content is broken.

In terms of incidental questions, there was a significant effect of the position of questions within the prose. Questions before the passages tended to reduce retention of information from other portions of the material. The largest inhibition of learning (i.e., scores lower than the control group) occurred for the incidental material when questions were placed before the passages (I refer you to Figure 1). In general, if acquisition of the total passage is the objective of instruction, then questions should be placed after the reading passages.

In contrast to the curvilinear relationship for retention questions, there was a gradual improvement in scores on incidental questions with the larger passages. This trend implies that whole

reading may be an optimal procedure if no precise guidence is to be given. Results, interestingly enough, seem to confirm both a small step approach (for retention of specific content) and a whole reading approach (for retention of general content).

SUMMARY

In summary, the most interesting results were these. First; they strongly support the data of Rothkopf. Second; the longer the passages the better the retention of incidental material. This was not the case for retention of relevant questions. Third; the tendency in both this study and the Rothkopf study was for the groups which had questions before the prose passages to score below the control group mean on incidental questions -- a focussing effect. Fourth; the most obvious effect was the widespread facilitation of retention when the question occurred after the reading passages. It could very well be that changing the position of a question changes its function. A factual question following a paragraph may act as an irrelevant question for the passage which follows it. Hence, the question would act as a cue to study all the factual material of the next paragraph.

The results of the present study are in accord with both the data and the mathemagenic theory postulated by Rothkopf. I have given a somewhat more molecular interpretation on the final pages of the handout. I have also listed briefly some implications of the operant theory suggested. Basically, the theory postulates that a question is a discriminative stimulus for an observing response. The reinforcing stimulus for the observing response is any question-correlated stimulus within the passage. A specific factual question (e.g., "When was James born?") may have one associate, if the question is of a comparative nature (e.g., "Was William older than Henry?") it should have several associates. I am now collecting norms on a small number of questions by asking subjects to underline words in prose passages which would comprise an answer to the questions. An index of diversity (number of words underlined divided by the total number of words in the passage) seems to give some indication of the specific or general acquisition potential of the questions. The questions should be related to the amount of incidental or relevant information acquired from prose passages to which they relate. A study is now underway in which an attempt is being made to relate this index of diversity to differential acquisition. The idea here is that if every sentence in a passage is related to the pre-question the attentive response is on a continuous schedule of reinforcement. If the question relevant sentences are randomized this would be analogous to a VR of reinforcement. Changing schedules of reinforcement (prose structure) in this way should have implication for the maintenance of attentive behaviors and hence for retention.

TABLE 1

Comparison of Percentages Correct with Data of Rothkopf[a]

	LBA	SB	SBA	SA	SAA	Control
Rothkopf[b]						
Retention	78	65	78	63	82	29
Incidental	36	30	35	43	40	33
Frase[c]						
Retention	85	61	87	79	91	68[d]
Incidental	52	54	53	73	70	61[d]

Note. -- LBA = all questions and answers were given, then Ss read passages (in the present study the 40-line length most nearly approaches this condition); SB = questions occurred before each paragraph; SBA = questions and answers given before each paragraph; SA = questions given after each paragraph; SAA = questions and answers given after each paragraph; Control = read prose passages.

[a]Data taken from Figure 8 in Rothkopf (1965)

[b]N 20

[c]N 18

[d]N 7

TABLE 2

Summary of Main Effects

	Retention Questions				Incidental Questions			
	Mean	F	df	p	Mean	F	df	p
Question Position		16.10	1/60	.001		22.00	1/60	.001
Before	15.14				10.67			
After	17.00				14.28			
Length of Passage		3.94	2/60	.02		Not significant		
10	15.96				11.33			
20	16.92				12.96			
40	15.33				13.13			
KR		52.20	1/60	.001		Not significant		
Present	17.78				12.28			
Absent	14.36				12.66			

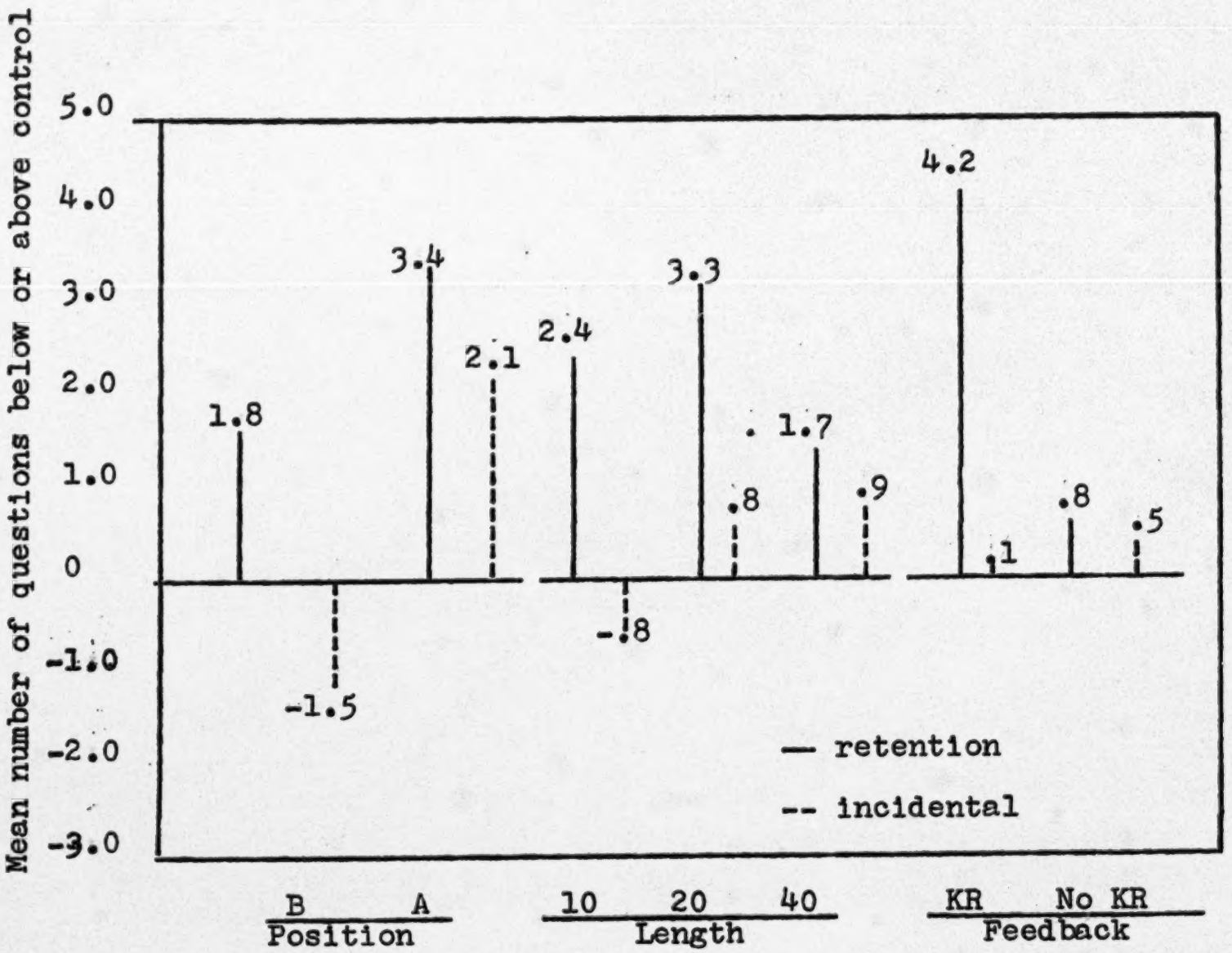

Figure 1. Comparison of control group mean with means of individual groups of retention and incidental questions.

Operant Paradigm of Prose Reading

S_{Q1} = specific question

$S_{Q1,2}$ = comparative question

R_O = observing response

S_1^D = prose associate of S_{Q1}

S_1^r = associate of S_{Q1} (as reinforcing event)

R_1 = correct response to S_{Q1}

Stage I. Test-taking experience

$$S_{Q1} \cdot R_O - S_r^D - R_1 - S^r \text{ (praise, passing grade, etc.)}$$

With test-taking experience (a form of concept formation in which S learns to respond appropriately in the presence of specific and comparative questions), S_n^D ("answers" or associates of questions) qcquire the capacity to reinforce R_O.

Stage II. Reading prose with questions

a. A specific question before a paragraph

$$S_{Q1} - R_O - S_1^r$$

b. A comparative question before a paragraph

$$S_{Q1,2} - R_O - \begin{cases} S_1^r \\ S_2^r \end{cases}$$

c. A specific question after a paragraph (followed by relevant question)

$$S_{Q1} - R_O - \begin{cases} S_3^r \ (S_3^D) - R_3 - S_3^r \\ S_4^r \\ S_5^r \end{cases}$$

d. A comparative question after a paragraph (followed by relevant question)

$$S_{Q1,2} - R_O - \begin{cases} S_3^r \ (S\ ) - R_{3,4} - S_{3,4}^r \\ S_4^r \ (S_4^D) \\ S_5^r \end{cases}$$

The emphasis in (c) and (d) is upon the broad range of stimuli which can reinforce R_O. Not included in the diagrams (in the interest of clarity of presentation) is the assumption that Ss respond to S_Q in terms of the concept "factual or specific" or "comparative". These concepts are developed during test-taking experience and are implied in Stage 1.

Implications of the Theory

1. Distinction between specific and general questions

A question stem S_Q^D has few associates (specific question) or many (multiple choice or comparative questions). The generalization effects of a question may be defined in terms of the number of words or sentences in the prose which Ss indicate are associates of S_Q^D.

General questions, with more associates, provide more reinforcement for R_O. The effect of general questions may extinguish more rapidly than with specific questions since R_O is maintained at a higher rate, but for general acquisition these questions should be more effective initially.

2. An alternative view would be that the reinforcement event S_1^r is really an S_1^D, i.e., content associated with S_Q^D is a discriminative stimulus for R_O. The assumption of the present view is that R_O is already occurring and that the rate of R_O is selected by S^r. Subjects do not gaze blankly at prose until, by chance, they are somehow stimulated by an S^D. They do attend while reading, the problem is why they emit more attentive responses at particular points. Placing the weight of explanation on the reinforcement mechanism (rather that S^D)implies that generalization of the effects of the question occurs at the point of contact with the associated stimulus material, not before, and that this generalization is defined in terms of R_O. In the final analysis, of course, R_O is defined in terms of test scores.

3. Distinction between questions before and after paragraphs

With a general question before a paragraph R_O is reinforced more often by virtue of its larger number of associates, hence general questions should be more facilitating than specific questions before prose passages.

A specific question and a general question after a paragraph act as irrelevant questions preceding the next paragraph. The number of associates of a specific question should be high under these conditions (any fact), perhaps too high. The associates of the general question should be roughly equivalent. R_O should extinguish more rapidly when S_Q comes after passages because it is emitted at a high rate, yet when the relevant question does occur only a few responses are reinforced. The implication is that questions after passages are initially facilitating, but because R_O extinguishes more rapidly with long reading passages, extinction of the previously learned test-taking or mathemagenic behaviors occurs. The present paradigm implies an interaction between question position and question type.

A basic assumption here is that a stimulus is most effective when acting in a forward manner. Hence, the effect of "review" questions (after passages) may be to facilitate performance on the paragraphs following the review.